



Illinois Department of Transportation

Memorandum

To: ALL BRIDGE DESIGNERS 03.8
From: Ralph E. Anderson *Ralph E. Anderson*
Subject: LRFD and LFD Standard Splices for Plate Girders
Date: December 30, 2003

This memorandum is the sixth in a series detailing the Departments policies and procedures for implementation of the AASHTO LRFD Bridge Design Specifications by October 1, 2007. It pertains to an IDOT developed standard splice design procedure for plate girders. The described procedure and splice designs for plate girders contained in this memorandum complete the Departments initiative for standardization of primary steel beam connections.

Just as for rolled shapes (ABD 03.4), the splice designs and procedure presented herein are valid for both the 1998 AASHTO LRFD Specifications through the 2003 interims and 2002 LFD Standard Specifications. This is beneficial as the Department is undergoing a transition period between the two codes. Standard splice designs for Grade 50 and 70 steels are included along with a design example. There are 51 Grade 50 and 43 Grade 70 web splice designs. For flange splices, there are 109 Grade 50 and 107 Grade 70.

The standard splice designs shall be applicable to all LRFD and LFD design plans prepared from TSL plans approved after February 1, 2004 and may be used, when feasible for bridges where the final design plans have not been completed.

SYK/ZBU/bb25516

Design Procedure

LRFD and LFD Splices for Typical Illinois Bridges Plate Girders

General

Standard splice designs for webs and flanges of plate girders were developed (Figs. 1 and 2, and Tables 1 through 4) according to applicable sections, sub-sections and referenced sections of LRFD 6.13.1 & .2 (1998 Edition through 2003 Interims) and the Standard Specifications for Highway Bridges (2002 Edition) 10.18.1 & .2. The standardized details are appropriate when splices are located at or near dead load contraflexure points (LRFD 6.13.6.1.4a, LFD 10.18.2.2.1), i.e. $\pm 5\%$ of span length, and are valid for superstructures designed according to AASHTO LRFD and LFD. For this reason, the more conservative specification governed that aspect of standard splice design. Splices for other compact webs or flanges meeting the general requirements above can be designed using the procedure outlined below.

The developed procedure is very similar to that for compact rolled shapes published by IDOT in ABD 03.4, but has some important differences. The employed design loads used for plate girder splices are more conservative than for rolled beams, 100% of capacity versus 75%. The elevation of design loads is beneficial in a standardized specification of plate girder splices for interconnected reasons. Splice designs for webs and flanges can be considered completely independent entities. Thus; asymmetry, stability, unbalanced moments, etc. in an individual or set of plate girders to be spliced are not of great concern. Individual specification of web and flange splices also allows for a very large number of possible combinations from Tables 1 through 4.

Materials

Structural Steel

Splices for plate girders using both Grade 50 and Grade 70 Steels were developed. The following basic material properties apply:

| | | |
|-----------------------------|------------------------|--------------------------|
| AASHTO M270 Grade 50 | $F_y = 50 \text{ ksi}$ | $F_u = 65 \text{ ksi}$ |
| AASHTO M270 Grade 50W | $F_y = 50 \text{ ksi}$ | $F_u = 65 \text{ ksi}^*$ |
| AASHTO M270 Grade HPS70W ** | $F_y = 70 \text{ ksi}$ | $F_u = 90 \text{ ksi}$ |

* Reduced from 70 ksi

** Flanges only

Bolts

All bolts in standard splice designs are AASHTO M 164 (ASTM A 325) 7/8" ϕ with Class A Contact Surfaces and Standard Sized Holes.

Design Forces

General

Splices are designed for not less than 100% of the capacity (resistance/design strength) of the member (modified LRFD 6.13.1 and LFD 10.18.1.1). Computed design forces are considered factored ultimate loads even though they are not explicitly "factored" in the conventional sense according to LFD and LRFD.

Flange Plates

The design stress for each specification is,

$$F_{cf} = 1.0\alpha\phi_f F_{yf} \quad (\text{modified LRFD 6.13.6.1.4c})$$

Where :

$$\alpha = 1.0, \phi_f = 1.0, F_{yf} = 50 \text{ or } 70 \text{ ksi}$$

and,

$$F_{cu} = 1.0\alpha F_{yf} \quad (\text{modified LFD 10.18.2.2})$$

Where :

$$\alpha = 1.0, F_{yf} = 50 \text{ or } 70 \text{ ksi}$$

Other cases (compression, "non-controlling" flange plates for asymmetrical connections) stated in the above sections of both specifications do not apply for standard splices.

Design stress is multiplied by an Effective Area (A_e) for determination of final factored flange splice plate design force. In LRFD, Effective Area is calculated from,

$$A_e = A_n + \beta A_g \leq A_g \quad (\text{LRFD 6.10.3.6})$$

Where :

A_n = Net Area of Flange (LRFD 6.8.3)

A_g = Gross Area of Flange

$$\beta = \left(\frac{A_n}{A_g} \right) \left(\left[\frac{\phi_u F_u}{\phi_y F_{yf}} \right] - 1 \right)$$

ϕ_u = resistance factor for fracture in tension (LRFD 6.5.4.2)

ϕ_y = resistance factor for yield in tension (LRFD 6.5.4.2)

$$F_u = 65 \text{ or } 90 \text{ ksi}$$

And for LFD it is,

$$A_e = W_n t + \beta A_g \leq A_g \quad (\text{LFD 10.18.2.2.4})$$

Where :

W_n = Least net width of the flange for design force determination, or
that of splice plate for strength check (LFD 10.16.14)

t = flange or splice plate thickness

A_g = Gross Area of Flange

$\beta = 0.15$

The larger force calculated from the two code procedures governs for an individual standard splice.

Web Plates

Section 6.13.6.1.4b of LRFD and LFD 10.18.2.3 give the methodology for calculation of web plate factored design shear. Both codes are equivalent with only differing notations employed. In LRFD terminology (modified), the design force is computed as,

$$V_{uw} = 1.0 V_r$$

Where :

V_r = factored shear resistance at the point of splice

(LRFD 6.10.7.1, LFD 10.48.8.1. Note : Both codes produce the same shear resistance. The units, lbs vs. kips, are different and $\phi_v = 1.0$ in LRFD)

The considered design moment for the web plates is found by multiplying the design shear from above by the distance from the centroid of the connection as a whole to the centroid of a web bolt group on one member being connected.

Slip

The design slip forces for bolts are service factored loads, not ultimate factored loads (LRFD 6.13.2.2, 6.13.6.1.4b, 6.13.6.1.4c; and LFD 10.18.2.2.2, 10.18.2.3.5). In LRFD, the calculated forces from Service Load Case II are appropriate while in LFD the case to be used is commonly referred to as Overload. The smallest ultimate load factor in either LRFD or LFD is 1.25. Multiplying the inverse of 1.25 by the ultimate factored computed loads above for the flange and web plates provides a conservative estimate of the design slip force for standardized splices.

Bolt Shear and Bearing

The design tension divided by the number of bolts on one side of the connection is the design force per bolt or bearing surface for both LRFD and LFD in the flanges.

The design bolt shear and bearing forces in the web plates is arrived at by combining the effects derived from the design shear and moment in the web connection. The design force per bolt or bearing surface due to design shear is computed as above for the flange

plates. The added design force due to moment is computed using the design shear only and a polar moment of inertia formulation as for an eccentric shear connection.

Design Resistances

Flange Plates

In LRFD, tension on the gross section (6.13.5.2) and fracture on the net section (6.13.5.2) must be checked as potential failure modes for the flange splice plates. These are conventional checks identical to those of simple tension members. Typically, splices are not susceptible to block shear. Consequently, LRFD Article 6.13.4 is not applicable to standard splice designs. Tension on the Effective Area as defined above need only be checked in LFD (10.18.2.2).

Web Plates

In LRFD, shear on the gross section ($\phi_v 0.58 F_y A_g$) (Art. 6.13.5.3) and flexure on the gross section (M_c/I_g less than $\phi_v F_y$) (Art. 6.13.6.1.4b) must be checked for the web plates. These are conventional checks identical to those for simple flexural members. Typically, splices are not susceptible to block shear. Consequently, LRFD Article 6.13.4 is not applicable to standard splice designs. Similar shear and flexure checks on the gross section are required in LFD (10.18.2.3).

Bolt Shear

The factored resistance of bolts subjected to shear using LRFD is given in 6.13.2.7,

$$\phi_s R_n = \phi_s 0.38 A_b F_{ub} N_s = 21.94 N_s \text{ kips/bolt}$$

Where :

$$\phi_s = 0.8$$

$$A_b = 0.6013 \text{ in}^2$$

$$F_{ub} = 120 \text{ ksi}$$

N_s = Number of Shear Planes

For LFD, the applicable article is 10.56.1.3.2,

$$\phi R = \phi F A_b N_s = 21.05 N_s \text{ kips/bolt}$$

Where :

$$\phi F = 35 \text{ ksi}$$

$$A_b = 0.6013 \text{ in}^2$$

N_s = Number of Shear Planes

The lesser value (21.05) was used for resistance of the bolts.

Bolt Bearing

Bearing resistance in LRFD is described in section 6.13.2.9

$$\phi_{bb} R_n = \phi_{bb} 1.2 L_c t F_u = 62.40t \text{ or } 86.40t \text{ kips/bolt}$$

Where :

$$\phi_{bb} = 0.8$$

$$L_c = 1"$$

t = bearing surface thickness

$$F_u = 65 \text{ or } 90 \text{ ksi}$$

In LFD (10.56.1.3.2) it is,

$$\phi R = 0.9 L_c t F_u = 58.5t \text{ or } 81.0t \text{ kips/bolt}$$

Where :

$$L_c = 1"$$

t = bearing surface thickness

$$F_u = 65 \text{ or } 90 \text{ ksi}$$

The lesser values (LFD's) were used for resistance to bearing forces.

Slip

All bolts in standard splice designs are AASHTO M 164 (ASTM A 325) 7/8" ϕ with Class A Contact Surfaces and Standard Sized Holes. The factored resistance per bolt in LRFD (6.13.2.8) given by,

$$\phi R_n = \phi K_h K_s N_s P_t = 12.87 N_s \text{ kips/bolt}$$

Where :

$$\phi = 1.0$$

$$K_h = 1.0$$

$$K_s = 0.33$$

N_s = Number of Slip Planes

P_t = Minimum Required Bolt Tension, 39 kips

For LFD (10.57.3), the factored resistance per bolt is,

$$\phi R_s = \phi F_s A_b N_s = 12.63 N_s \text{ kips/bolt}$$

Where :

$$\phi F_s = 21 \text{ ksi}$$

N_s = Number of Slip Planes

$$A_b = 0.6013 \text{ in}^2$$

The lesser value (12.63) was used for slip resistance of the bolts.

Splice Geometry

Flange

Double flange plates were employed for all standard splices. Stagger was employed for smaller width flanges. Staggered bolt patterns were geometrically optimized to produce the shortest flange splice plate lengths.

Web

Web bolt patterns did not employ stagger. The maximum number of bolts in a row were geometrically fitted as recommended by the specifications.

Special Notes

All web and flange cross sections in Tables 1 through 4 are compact according to appropriate sections of the LRFD and LFD codes.

Tables 1 and 2 are for plate girders with flanges and webs which are fabricated from 50 ksi steel.

Tables 3 and 4 are for plate girders fabricated with 70 ksi flanges and 50 ksi webs. Compactness of the webs for hybrid girders is dependant upon the yield point of compression flanges.

In accordance with the commentary of LRFD Article 6.13.6.1.5, the provisions concerning filler plates are not applicable to these splices.

As outlined in LRFD Article 6.13.6.1.1 and LFD Article 10.18.1.1, the smaller of the connected plate girder section (i.e. the section with the least moment resistance) shall be used in the design of the splice. See also Figs. 1 and 2.

Standard Splice Example
13" x 3/4" Flanges with
42" x 1/2" Web

Materials

Structural Steel (web and flanges)

AASHTO M270 Grade 50

$$F_y = 50 \text{ ksi}$$

$$F_u = 65 \text{ ksi}$$

Bolts

AASHTO M 164 (ASTM A 325) 7/8"φ with Class A Contact Surfaces and Standard Sized Holes.

Design Forces

Flange Plates

LRFD Design Stress

$$F_{cf} = 1.0\alpha\phi_f F_{yf} = 50 \text{ ksi}$$

Where :

$$\alpha = 1.0, \phi_f = 1.0, F_{yf} = 50 \text{ ksi}$$

LFD Design Stress,

$$F_{cu} = 1.0\alpha F_{yf} = 50 \text{ ksi}$$

Where :

$$\alpha = 1.0, F_{yf} = 50 \text{ ksi}$$

LRFD Effective Area (4 bolts w/ stagger (governs)),

$$A_e = A_n + \beta A_g \leq A_g$$

$$A_n = (13 \times 0.75) - [(7/8 + 1/8) \times 4 \times 0.75] + \left(2 \times \frac{2^2}{4 \times 2.25} \times 0.75 \right) = 7.42 \text{ in}^2 \text{ (w/ stagger)}$$

$$A_g = 13.0 \times 0.75 = 9.75 \text{ in}^2$$

$$\beta = \left(\frac{A_n}{A_g} \right) \left(\left[\frac{\phi_u F_u}{\phi_y F_{yf}} \right] - 1 \right) = \left(\frac{7.42}{9.75} \right) \left(\frac{0.8 \times 65}{0.95 \times 50} - 1 \right) = 0.072$$

$$\phi_u = 0.80, \phi_y = 0.95$$

$$A_e = 7.42 + (0.072 \times 9.75) = 8.12 < 9.75 \therefore \text{Use } 8.12 \text{ in}^2$$

LFD Effective Area (4 bolts w/ stagger (governs)),

$$A_e = W_n t + \beta A_g \leq A_g$$

$$W_n = 13 - [(7/8 + 1/8) \times 4] + \left(2 \times \frac{2^2}{4 \times 2.25} \right) = 9.89 \text{ in (w/ stagger)}$$

$$t = 0.75 \text{ in}, A_g = 9.75 \text{ in}^2, \beta = 0.15$$

$$A_e = (9.89 \times 0.75) + (0.15 \times 9.75) = 8.88 < 9.75 \therefore \text{Use } 8.88 \text{ in}^2$$

LFD governs the Flange Splice Plate Design Force :

$$P_{\text{Design Flange (Ultimate)}} = 8.88 \text{ in}^2 \times 50 \text{ ksi} = 444 \text{ kips}$$

$$P_{\text{Design Flange (Service)}} = \frac{444 \text{ kips}}{1.25} = 355 \text{ kips}$$

Web Plates

The design shear force for LRFD and LFD is,

$$V_{uw} = 380.5 \text{ kips}$$

$$V_{\text{Design Web (Ultimate)}} = 1.0 \times V_{uw} = 1.0 \times 380.5 = 380.5 \text{ kips}$$

$$V_{\text{Design Web (Service)}} = \frac{380.5 \text{ kips}}{1.25} = 304.4 \text{ kips}$$

The design moment for LRFD and LFD is,

Bolt pattern → 2 vertical lines of bolts with 13 bolts per line at 3" spacing.

Moment arm = 2" + 1 1/2" = 3 1/2" (see Fig. 1)

$$M_{\text{Design Web (Ultimate)}} = 3 \frac{1}{2}'' \times 380.5 \text{ kips} = 1332 \text{ kip-in}$$

$$M_{\text{Design Web (Service)}} = \frac{1332 \text{ kip-in}}{1.25} = 1066 \text{ kip-in}$$

Trial Design

Flange Plates/Bolts

No of bolts based on slip,

$$N_b = \frac{355 \text{ kips}}{(21 \times 0.6013)^{\text{kips/bolt}} \times 2 \text{ slip planes}} = 14.06 \text{ bolts} \therefore \text{Try 8 staggered rows with 4 lines parallel to line of force} = 16 \text{ bolts/flange}$$

Plate Dimensions (Width and Thickness),

Top Flange Width = 13 in → ∴ Try an outside plate width of 13"

Try an inside plate width :

$$\frac{13}{2} - 1.5" = 5.0 "$$

(1.5" gives adequate web clearance)

Top Flange Thickness = 0.75 in → ∴ Try an outside plate thickness of $\frac{1}{16}$ "

Try an inside plate thickness of $\frac{3}{4}$ "

Web Plates/Bolts

Assumed bolt pattern,

2 vertical lines of bolts with 13 bolts per line at 3" spacing.

$$I_x = 2 \text{ bolts per horizontal row} \times \sum_{i=1}^{n_{\text{rows}}} y_i^2 = 3276 \text{ in}^2$$

$$I_y = 13 \text{ bolts per vertical line} \times \sum_{i=1}^{n_{\text{lines}}} x_i^2 = 58.5 \text{ in}^2$$

$$I_p = 3276 + 58.5 = 3334.5 \text{ in}^2$$

Max. Service Force "Extreme Fiber" Bolt

$$V_{\text{force/bolt per shear plane}} = \frac{304.4 \text{ kips}}{26 \text{ bolts} / 2 \text{ planes}} = 5.9 \text{ kips from pure shear} \downarrow$$

$$V_{\text{force/bolt per shear plane}} = \frac{1066 \text{ kip-in} \times 1\frac{1}{2} \text{ in}}{3334.5 \text{ in}^2 / 2 \text{ planes}} = 0.24 \text{ kips max. shear from moment} \downarrow$$

$$V_{\text{force/bolt per shear plane}} = \frac{1066 \text{ kip-in} \times 18 \text{ in}}{3334.5 \text{ in}^2 / 2 \text{ planes}} = 2.88 \text{ kips max. shear from moment} \rightarrow$$

$$V_{\text{Total force/bolt per shear plane}} = \sqrt{(5.9 + 0.24)^2 + 2.88^2} = 6.78 \text{ kips max.} < 0.6013 \times 21 \text{ kips}$$

allowable for slip ∴ OK

Plate Dimensions (Height and Thickness),

Member Depth = 42 in. $\rightarrow \therefore$ Try a plate height of 39"

$$42" - 3" = 39"$$

$(2 \times 1.5"$ gives adequate top and bottom
flange clearance $)$

Web Thickness = 0.50 in $\rightarrow \therefore$ Try a plate thickness of $\frac{3}{8}"$

Ultimate Strength Checks

Flange Plates/Bolts

Bolt Shear,

$$P_{\text{Design force/bolt per shear plane}} = \frac{444 \text{ kips}}{2 \text{ planes} \times 16 \text{ bolts}} = 13.9 \text{ kips}$$

$$P_{\text{Allowable force/bolt per shear plane}} = 35 \times 0.6013 = 21.05 \text{ kips} \therefore \text{OK}$$

Bolt Bearing,

$$P_{\text{Design force per bearing surface}} = \frac{444 \text{ kips}}{16 \text{ surfaces}} = 27.8 \text{ kips}$$

$$P_{\text{Allowable force per bearing surface}} = 0.9 \times L_c \times F_u \times 0.75" \quad (L_c = 1", F_u = 65 \text{ ksi}) \\ 58.5 \times 0.75" = 43.9 \text{ kips} \therefore \text{OK}$$

LRFD Tension on Gross Section,

$$P_{\text{Design force}} = 444 \text{ kips}$$

$$P_{\text{Allowable force}} = \phi_y A_g F_y = 0.95 \times [(1\frac{1}{16} \times 13) + 2 \times (5 \times \frac{3}{4})] \times 50 = 781 \text{ kips} \therefore \text{OK}$$

LRFD Tension on Net Section,

$$P_{\text{Design force}} = 444 \text{ kips}$$

$$P_{\text{Allowable force}} = \phi_u A_n F_u$$

$$\text{Outside plate } A_n = 1\frac{1}{16} \times \left\{ [13 - 4 \times (\frac{7}{8} + \frac{1}{8})] + \left(2 \times \frac{2^2}{4 \times 2.25} \right) \right\} \\ = 6.8 \text{ in}^2 \text{ (w/ stagger)}$$

$$\text{Inside Plates } A_n = 2 \times \left\{ \frac{3}{4} \times \left\{ [5 - 2 \times (\frac{7}{8} + \frac{1}{8})] + \left(1 \times \frac{2^2}{4 \times 2.25} \right) \right\} \right\} \\ = 5.17 \text{ in}^2 \text{ (w/ stagger)}$$

$$\therefore A_n = 6.8 + 5.17 = 11.97 \text{ in}^2$$

$$P_{\text{Allowable force}} = \phi_u A_n F_u = 0.80 \times 11.97 \times 65 = 622 \text{ kips} > 444 \text{ kips} \therefore \text{OK}$$

LFD Tension on Effective Area,

$$P_{\text{Design force}} = 444 \text{ kips}$$

$$A_e = W_n t + \beta A_g \leq A_g$$

$$W_{n \text{ outside plate}} = 13 - [(\frac{7}{8} + \frac{1}{8}) \times 4] + \left(2 \times \frac{2^2}{4 \times 2.25} \right) = 9.89 \text{ in (w/ stagger)}$$

$$t_{\text{outside plate}} = \frac{11}{16} \text{ in}, A_{g \text{ top plate}} = 8.94 \text{ in}^2, \beta = 0.15$$

$$A_{e \text{ outside plate}} = (9.89 \times \frac{11}{16}) + (0.15 \times 8.94) = 8.14 < 8.94 \therefore \text{Use } 8.14 \text{ in}^2$$

$$W_{n \text{ inside plates}} = (5 \times 2) - [(\frac{7}{8} + \frac{1}{8}) \times 4] + \left(2 \times \frac{2^2}{4 \times 2.25} \right) = 6.89 \text{ in (w/ stagger)}$$

$$t_{\text{inside plates}} = \frac{3}{4} \text{ in}, A_{g \text{ bot plates}} = 7.5 \text{ in}^2, \beta = 0.15$$

$$A_{e \text{ inside plates}} = (6.89 \times \frac{3}{4}) + (0.15 \times 7.5) = 6.29 < 7.5 \therefore \text{Use } 6.29 \text{ in}^2$$

$$A_{e \text{ total}} = 8.14 + 6.29 = 14.43 \text{ in}^2$$

$$P_{\text{Allowable force}} = A_{e \text{ total}} F_y = 14.43 \times 50 = 722 \text{ kips} > 444 \text{ kips} \therefore \text{OK}$$

Web Plates/Bolts

Max. Bolt Shear,

$$V_{\text{force/bolt per shear plane}} = \frac{380.5 \text{ kips}}{26 \text{ bolts} / 2 \text{ planes}} = 7.3 \text{ kips from pure shear} \downarrow$$

$$V_{\text{force/bolt per shear plane}} = \frac{1332 \text{ kip-in} \times 1.5 \text{ in}}{3334.5 \text{ in}^2 / 2 \text{ planes}} = .30 \text{ kips max. shear from moment} \downarrow$$

$$V_{\text{force/bolt per shear plane}} = \frac{1332 \text{ kip-in} \times 18 \text{ in}}{3334.5 \text{ in}^2 / 2 \text{ planes}} = 3.6 \text{ kips max. shear from moment} \rightarrow$$

$$V_{\text{Design force/bolt per shear plane}} = \sqrt{(7.3 + 0.3)^2 + 3.6^2} = 8.41 \text{ kips max.}$$

$$V_{\text{Allowable force/bolt per shear plane}} = 35 \times 0.6013 = 21.05 \text{ kips} \therefore \text{OK}$$

Max. Bolt Bearing,

$$V_{\text{Design force per bearing surface}} = \frac{380.5 \text{ kips}}{26 \text{ bolts}} = 14.6 \text{ kips from pure shear} \downarrow$$

$$V_{\text{Design force per bearing surface}} = \frac{1332 \text{ kip - in} \times 1.5 \text{ in}}{3334.5 \text{ in}^2} = 0.6 \text{ kips max from moment} \downarrow$$

$$V_{\text{Design force per bearing surface}} = \frac{1332 \text{ kip - in} \times 18 \text{ in}}{3334.5 \text{ in}^2} = 7.2 \text{ kips max from moment} \rightarrow$$

$$V_{\text{Design Total force per bearing surface}} = \sqrt{(14.6 + 0.6)^2 + 7.2^2} = 16.8 \text{ kips max}$$

$$V_{\text{Allowable force per bearing surface}} = 0.9 \times L_c \times F_u \times 0.715" \quad (L_c = 1", F_u = 65 \text{ ksi})$$

$$58.5 \times 0.715" = 41.8 \text{ kips} \therefore \text{OK}$$

Flexure in Plates,

$$I_{\text{plates gross}} = \frac{1}{12} b h^3 = \frac{1}{12} \times 0.75 \times (39)^3 = 3707 \text{ in}^4$$

$$c_{\text{dis. extreme fiber}} = \frac{39}{2} = 19.5 \text{ in}$$

$$\sigma_{\text{Design stress}} = \frac{1332 \times 19.5}{3707} = 7.0 \text{ ksi}$$

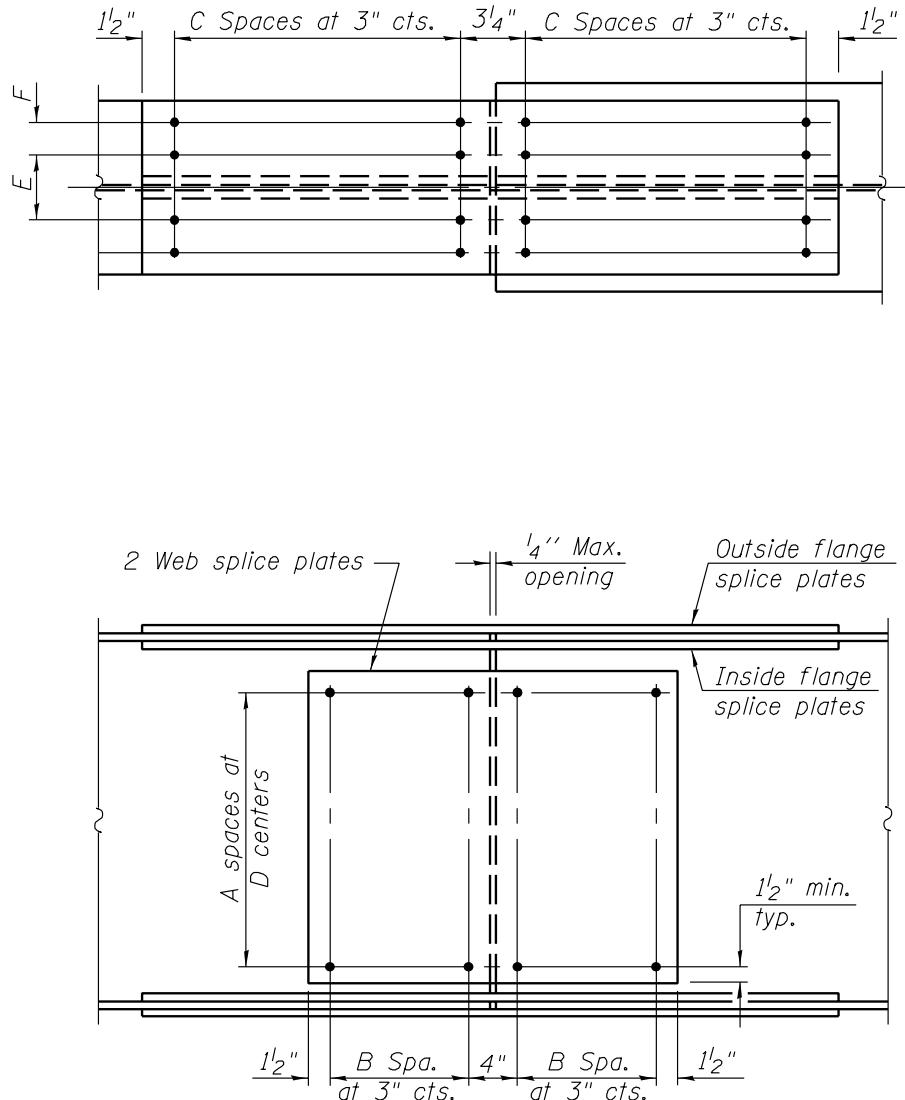
$$\sigma_{\text{Allowable stress}} = 50 \text{ ksi} \therefore \text{OK}$$

Shear in Plates,

$$V_{\text{Design force}} = 380.5 \text{ kips}$$

$$V_{\text{Allowable force}} = 0.58 \times 50 \times 39 \times 0.75 = 848 \text{ kips} \therefore \text{OK}$$

**LRFD & LFD STANDARD BEAM SPLICES
FOR 100 PERCENT OF BEAM SECTION
BASED ON A.A.S.H.T.O. M270 GR50 & GR HPS70W**



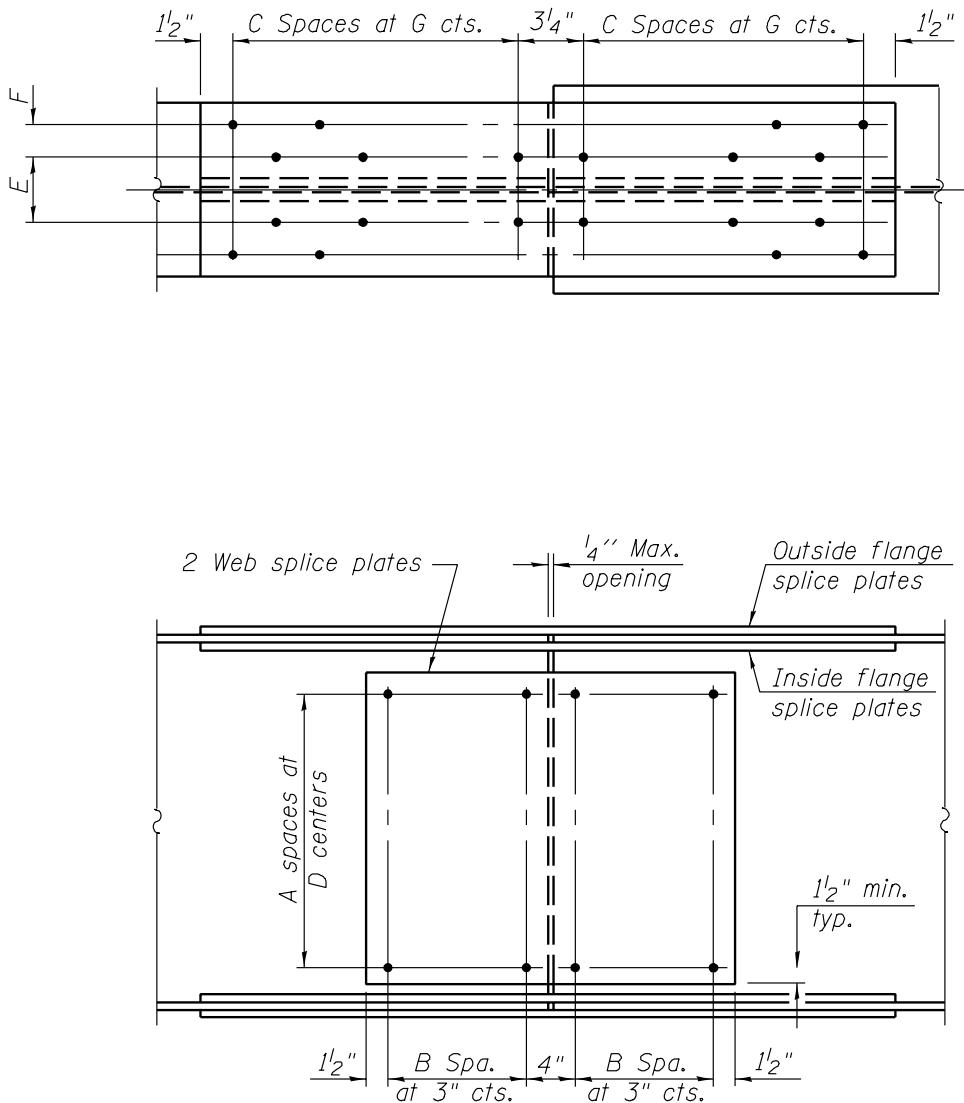
SPLICE WITH INSIDE AND OUTSIDE FLANGE PLATES

High strength bolts shall conform to AASHTO M-164 specification (ASTM A 325). Bolts $\frac{7}{8}'' \phi$, open holes $\frac{15}{16}'' \phi$.

STANDARD BEAM SPLICES

Figure 1

*LRFD & LFD STANDARD BEAM SPLICES
FOR 100 PERCENT OF BEAM SECTION
BASED ON A.A.S.H.T.O. M270 GR50 & GR HP570W*



SPLICE WITH INSIDE AND OUTSIDE FLANGE PLATES

High strength bolts shall conform to AASHTO M-164 specification (ASTM A 325). Bolts $\frac{7}{8}$ " ϕ , open holes $\frac{15}{16}$ " ϕ .

STANDARD BEAM SPLICES

Figure 2

| | |
|-------|--------|
| Steel | 50 ksi |
|-------|--------|

Web Splices

| Web Size | | Plate Size | | | | | |
|-------------------|-----------------------|-----------------------|--------------------|--------------------|----|---------------|---|
| Depth (inches) | Thickness (inches) | Thickness (inches) | Length (inches) | Height (inches) | A | D (inches) | B |
| 40 | 1/2 | 3/8 | 13 | 37 | 11 | 3 | 1 |
| 40 | 9/16 | 3/8 | 13 | 37 | 11 | 3 | 1 |
| 40 | 5/8 | 3/8 | 19 | 37 | 11 | 3 | 2 |
| 42 | 1/2 | 3/8 | 13 | 39 | 12 | 3 | 1 |
| 42 | 9/16 | 3/8 | 13 | 39 | 12 | 3 | 1 |
| 42 | 5/8 | 3/8 | 13 | 39 | 12 | 3 | 1 |
| 44 | 9/16 | 3/8 | 13 | 41 | 12 | 3 1/8 | 1 |
| 44 | 5/8 | 3/8 | 13 | 41 | 12 | 3 1/8 | 1 |
| 44 | 11/16 | 3/8 | 19 | 41 | 12 | 3 1/8 | 2 |
| 46 | 9/16 | 3/8 | 13 | 43 | 13 | 3 | 1 |
| 46 | 5/8 | 3/8 | 13 | 43 | 13 | 3 | 1 |
| 46 | 11/16 | 3/8 | 19 | 43 | 13 | 3 | 2 |
| 48 | 9/16 | 3/8 | 13 | 45 | 14 | 3 | 1 |
| 48 | 5/8 | 3/8 | 13 | 45 | 14 | 3 | 1 |
| 48 | 11/16 | 3/8 | 13 | 45 | 14 | 3 | 1 |
| 50 | 5/8 | 3/8 | 13 | 47 | 14 | 3 1/8 | 1 |
| 50 | 11/16 | 3/8 | 13 | 47 | 14 | 3 1/8 | 1 |
| 50 | 3/4 | 7/16 | 19 | 47 | 14 | 3 1/8 | 2 |
| 52 | 5/8 | 3/8 | 13 | 49 | 15 | 3 | 1 |
| 52 | 11/16 | 3/8 | 13 | 49 | 15 | 3 | 1 |
| 52 | 3/4 | 7/16 | 19 | 49 | 15 | 3 | 2 |
| 54 | 11/16 | 3/8 | 13 | 51 | 16 | 3 | 1 |
| 54 | 3/4 | 7/16 | 19 | 51 | 16 | 3 | 2 |
| 54 | 13/16 | 7/16 | 19 | 51 | 16 | 3 | 2 |
| 56 | 11/16 | 3/8 | 13 | 53 | 16 | 3 1/8 | 1 |
| 56 | 3/4 | 7/16 | 19 | 53 | 16 | 3 1/8 | 2 |
| 56 | 13/16 | 7/16 | 19 | 53 | 16 | 3 1/8 | 2 |
| 58 | 11/16 | 3/8 | 13 | 55 | 17 | 3 | 1 |
| 58 | 3/4 | 7/16 | 13 | 55 | 17 | 3 | 1 |
| 58 | 13/16 | 7/16 | 19 | 55 | 17 | 3 | 2 |
| 60 | 3/4 | 7/16 | 13 | 57 | 18 | 3 | 1 |
| 60 | 13/16 | 7/16 | 19 | 57 | 18 | 3 | 2 |
| 60 | 7/8 | 1/2 | 19 | 57 | 18 | 3 | 2 |
| 62 | 3/4 | 7/16 | 13 | 59 | 18 | 3 | 1 |
| 62 | 13/16 | 7/16 | 19 | 59 | 18 | 3 | 2 |
| 62 | 7/8 | 1/2 | 19 | 59 | 18 | 3 | 2 |
| 64 | 3/4 | 7/16 | 13 | 61 | 19 | 3 | 1 |
| 64 | 13/16 | 7/16 | 13 | 61 | 19 | 3 | 1 |
| 64 | 7/8 | 1/2 | 19 | 61 | 19 | 3 | 2 |
| 66 | 13/16 | 7/16 | 13 | 63 | 20 | 3 | 1 |
| 66 | 7/8 | 1/2 | 19 | 63 | 20 | 3 | 2 |
| 66 | 15/16 | 1/2 | 19 | 63 | 20 | 3 | 2 |
| 68 | 13/16 | 7/16 | 13 | 65 | 20 | 3 | 1 |
| 68 | 7/8 | 1/2 | 19 | 65 | 20 | 3 | 2 |
| 68 | 15/16 | 1/2 | 19 | 65 | 20 | 3 | 2 |
| 70 | 7/8 | 1/2 | 13 | 67 | 21 | 3 | 1 |
| 70 | 15/16 | 1/2 | 19 | 67 | 21 | 3 | 2 |
| 70 | 1 | 9/16 | 19 | 67 | 21 | 3 | 2 |
| 72 | 7/8 | 1/2 | 13 | 69 | 22 | 3 | 1 |
| 72 | 15/16 | 1/2 | 19 | 69 | 22 | 3 | 2 |
| 72 | 1 | 9/16 | 19 | 69 | 22 | 3 | 2 |

Table 1

Steel 50 ksi

Flange Splices

| Flange Size | | Outside Plate Size | | | Inside Plate Size | | | C | E (inches) | F (inches) | G (inches) |
|-----------------------|-------------------|-----------------------|-------------------|--------------------|-----------------------|-------------------|--------------------|----|---------------|---------------|---------------|
| Thickness (inches) | Width (inches) | Thickness (inches) | Width (inches) | Length (inches) | Thickness (inches) | Width (inches) | Length (inches) | | | | |
| 12 | 3/4 | 11/16 | 12 | 43 | 3/4 | 4 1/2 | 43 | 7 | 6 | 1 1/2 | 2 5/8 |
| 12 | 7/8 | 3/4 | 12 | 48 1/4 | 13/16 | 4 1/2 | 48 1/4 | 8 | 6 | 1 1/2 | 2 5/8 |
| 12 | 1 | 13/16 | 12 | 53 1/2 | 7/8 | 4 1/2 | 53 1/2 | 9 | 6 | 1 1/2 | 2 5/8 |
| 12 1/2 | 3/4 | 11/16 | 12 1/2 | 41 1/4 | 3/4 | 4 3/4 | 41 1/4 | 7 | 6 | 1 3/4 | 2 1/2 |
| 12 1/2 | 7/8 | 3/4 | 12 1/2 | 46 1/4 | 13/16 | 4 3/4 | 46 1/4 | 8 | 6 | 1 3/4 | 2 1/2 |
| 12 1/2 | 1 | 13/16 | 12 1/2 | 51 1/4 | 7/8 | 4 3/4 | 51 1/4 | 9 | 6 | 1 3/4 | 2 1/2 |
| 13 | 3/4 | 11/16 | 13 | 37 3/4 | 3/4 | 5 | 37 3/4 | 7 | 6 | 2 | 2 1/4 |
| 13 | 7/8 | 3/4 | 13 | 42 1/4 | 13/16 | 5 | 42 1/4 | 8 | 6 | 2 | 2 1/4 |
| 13 | 1 | 13/16 | 13 | 46 3/4 | 7/8 | 5 | 46 3/4 | 9 | 6 | 2 | 2 1/4 |
| 13 1/2 | 7/8 | 3/4 | 13 1/2 | 38 1/4 | 13/16 | 5 1/4 | 38 1/4 | 8 | 6 | 2 1/4 | 2 |
| 13 1/2 | 1 | 13/16 | 13 1/2 | 42 1/4 | 7/8 | 5 1/4 | 42 1/4 | 9 | 6 | 2 1/4 | 2 |
| 13 1/2 | 1 1/8 | 7/8 | 13 1/2 | 50 1/4 | 15/16 | 5 1/4 | 50 1/4 | 11 | 6 | 2 1/4 | 2 |
| 13 1/2 | 1 1/4 | 15/16 | 13 1/2 | 54 1/4 | 1 | 5 1/4 | 54 1/4 | 12 | 6 | 2 1/4 | 2 |
| 14 | 7/8 | 3/4 | 14 | 34 1/4 | 13/16 | 5 1/2 | 34 1/4 | 8 | 6 | 2 1/2 | 1 3/4 |
| 14 | 1 | 13/16 | 14 | 41 1/4 | 7/8 | 5 1/2 | 41 1/4 | 10 | 6 | 2 1/2 | 1 3/4 |
| 14 | 1 1/8 | 7/8 | 14 | 44 3/4 | 15/16 | 5 1/2 | 44 3/4 | 11 | 6 | 2 1/2 | 1 3/4 |
| 14 | 1 1/4 | 15/16 | 14 | 48 1/4 | 1 | 5 1/2 | 48 1/4 | 12 | 6 | 2 1/2 | 1 3/4 |
| 14 1/2 | 7/8 | 3/4 | 14 1/2 | 33 1/4 | 13/16 | 5 3/4 | 33 1/4 | 9 | 6 | 2 3/4 | 1 1/2 |
| 14 1/2 | 1 | 13/16 | 14 1/2 | 36 1/4 | 7/8 | 5 3/4 | 36 1/4 | 10 | 6 | 2 3/4 | 1 1/2 |
| 14 1/2 | 1 1/8 | 7/8 | 14 1/2 | 39 1/4 | 15/16 | 5 3/4 | 39 1/4 | 11 | 6 | 2 3/4 | 1 1/2 |
| 14 1/2 | 1 1/4 | 15/16 | 14 1/2 | 42 1/4 | 1 | 5 3/4 | 42 1/4 | 12 | 6 | 2 3/4 | 1 1/2 |
| 14 1/2 | 1 3/8 | 1 | 14 1/2 | 48 1/4 | 1 1/16 | 5 3/4 | 48 1/4 | 14 | 6 | 2 3/4 | 1 1/2 |
| 14 1/2 | 1 1/2 | 1 1/16 | 14 1/2 | 51 1/4 | 1 1/8 | 5 3/4 | 51 1/4 | 15 | 6 | 2 3/4 | 1 1/2 |
| 15 | 1 | 13/16 | 15 | 36 1/4 | 7/8 | 6 | 36 1/4 | 5 | 6 | 3 | |
| 15 | 1 1/8 | 7/8 | 15 | 36 1/4 | 15/16 | 6 | 36 1/4 | 5 | 6 | 3 | |
| 15 | 1 1/4 | 15/16 | 15 | 42 1/4 | 1 | 6 | 42 1/4 | 6 | 6 | 3 | |
| 15 | 1 3/8 | 1 | 15 | 48 1/4 | 1 1/16 | 6 | 48 1/4 | 7 | 6 | 3 | |
| 15 | 1 1/2 | 1 1/16 | 15 | 48 1/4 | 1 1/8 | 6 | 48 1/4 | 7 | 6 | 3 | |
| 15 | 1 5/8 | 1 1/8 | 15 | 54 1/4 | 1 3/16 | 6 | 54 1/4 | 8 | 6 | 3 | |
| 15 | 1 3/4 | 1 3/16 | 15 | 60 1/4 | 1 1/4 | 6 | 60 1/4 | 9 | 6 | 3 | |
| 15 1/2 | 1 | 13/16 | 15 1/2 | 36 1/4 | 7/8 | 6 1/4 | 36 1/4 | 5 | 6 | 3 1/4 | |
| 15 1/2 | 1 1/8 | 7/8 | 15 1/2 | 42 1/4 | 15/16 | 6 1/4 | 42 1/4 | 6 | 6 | 3 1/4 | |
| 15 1/2 | 1 1/4 | 15/16 | 15 1/2 | 42 1/4 | 1 | 6 1/4 | 42 1/4 | 6 | 6 | 3 1/4 | |
| 15 1/2 | 1 3/8 | 1 | 15 1/2 | 48 1/4 | 1 1/16 | 6 1/4 | 48 1/4 | 7 | 6 | 3 1/4 | |
| 15 1/2 | 1 1/2 | 1 1/16 | 15 1/2 | 54 1/4 | 1 1/8 | 6 1/4 | 54 1/4 | 8 | 6 | 3 1/4 | |
| 15 1/2 | 1 5/8 | 1 1/8 | 15 1/2 | 54 1/4 | 1 3/16 | 6 1/4 | 54 1/4 | 8 | 6 | 3 1/4 | |
| 15 1/2 | 1 3/4 | 1 3/16 | 15 1/2 | 60 1/4 | 1 1/4 | 6 1/4 | 60 1/4 | 9 | 6 | 3 1/4 | |
| 16 | 1 | 13/16 | 16 | 36 1/4 | 7/8 | 6 1/2 | 36 1/4 | 5 | 6 | 3 1/2 | |
| 16 | 1 1/8 | 7/8 | 16 | 42 1/4 | 15/16 | 6 1/2 | 42 1/4 | 6 | 6 | 3 1/2 | |
| 16 | 1 1/4 | 15/16 | 16 | 48 1/4 | 1 | 6 1/2 | 48 1/4 | 7 | 6 | 3 1/2 | |
| 16 | 1 3/8 | 1 | 16 | 48 1/4 | 1 1/16 | 6 1/2 | 48 1/4 | 7 | 6 | 3 1/2 | |
| 16 | 1 1/2 | 1 1/16 | 16 | 54 1/4 | 1 1/8 | 6 1/2 | 54 1/4 | 8 | 6 | 3 1/2 | |
| 16 | 1 5/8 | 1 1/8 | 16 | 60 1/4 | 1 3/16 | 6 1/2 | 60 1/4 | 9 | 6 | 3 1/2 | |
| 16 | 1 3/4 | 1 3/16 | 16 | 60 1/4 | 1 1/4 | 6 1/2 | 60 1/4 | 9 | 6 | 3 1/2 | |
| 16 | 1 7/8 | 1 1/4 | 16 | 66 1/4 | 1 5/16 | 6 1/2 | 66 1/4 | 10 | 6 | 3 1/2 | |
| 16 1/2 | 1 1/8 | 7/8 | 16 1/2 | 42 1/4 | 15/16 | 6 3/4 | 42 1/4 | 6 | 6 | 3 3/4 | |
| 16 1/2 | 1 1/4 | 15/16 | 16 1/2 | 48 1/4 | 1 | 6 3/4 | 48 1/4 | 7 | 6 | 3 3/4 | |
| 16 1/2 | 1 3/8 | 1 | 16 1/2 | 54 1/4 | 1 1/16 | 6 3/4 | 54 1/4 | 8 | 6 | 3 3/4 | |
| 16 1/2 | 1 1/2 | 1 1/16 | 16 1/2 | 54 1/4 | 1 1/8 | 6 3/4 | 54 1/4 | 8 | 6 | 3 3/4 | |
| 16 1/2 | 1 5/8 | 1 1/8 | 16 1/2 | 60 1/4 | 1 3/16 | 6 3/4 | 60 1/4 | 9 | 6 | 3 3/4 | |
| 16 1/2 | 1 3/4 | 1 3/16 | 16 1/2 | 66 1/4 | 1 1/4 | 6 3/4 | 66 1/4 | 10 | 6 | 3 3/4 | |
| 16 1/2 | 1 7/8 | 1 1/4 | 16 1/2 | 72 1/4 | 1 5/16 | 6 3/4 | 72 1/4 | 11 | 6 | 3 3/4 | |
| 16 1/2 | 2 | 1 5/16 | 16 1/2 | 72 1/4 | 1 3/8 | 6 3/4 | 72 1/4 | 11 | 6 | 3 3/4 | |

Table 2

| | |
|-------|--------|
| Steel | 50 ksi |
|-------|--------|

Flange Splices

| Flange Size | | Outside Plate Size | | | Inside Plate Size | | | C | E (inches) | F (inches) | G (inches) |
|-----------------------|-------------------|-----------------------|-------------------|--------------------|-----------------------|-------------------|--------------------|----|---------------|---------------|---------------|
| Thickness (inches) | Width (inches) | Thickness (inches) | Width (inches) | Length (inches) | Thickness (inches) | Width (inches) | Length (inches) | | | | |
| 17 | 1 1/8 | 7/8 | 17 | 42 1/4 | 15/16 | 7 | 42 1/4 | 6 | 6 | 4 | |
| 17 | 1 1/4 | 15/16 | 17 | 48 1/4 | 1 | 7 | 48 1/4 | 7 | 6 | 4 | |
| 17 | 1 3/8 | 1 | 17 | 54 1/4 | 1 1/16 | 7 | 54 1/4 | 8 | 6 | 4 | |
| 17 | 1 1/2 | 1 1/16 | 17 | 60 1/4 | 1 1/8 | 7 | 60 1/4 | 9 | 6 | 4 | |
| 17 | 1 5/8 | 1 1/8 | 17 | 66 1/4 | 1 3/16 | 7 | 66 1/4 | 10 | 6 | 4 | |
| 17 | 1 3/4 | 1 3/16 | 17 | 66 1/4 | 1 1/4 | 7 | 66 1/4 | 10 | 6 | 4 | |
| 17 | 1 7/8 | 1 1/4 | 17 | 72 1/4 | 1 5/16 | 7 | 72 1/4 | 11 | 6 | 4 | |
| 17 | 2 | 1 5/16 | 17 | 78 1/4 | 1 3/8 | 7 | 78 1/4 | 12 | 6 | 4 | |
| 17 1/2 | 1 1/8 | 7/8 | 17 1/2 | 48 1/4 | 15/16 | 7 1/4 | 48 1/4 | 7 | 6 | 4 1/4 | |
| 17 1/2 | 1 1/4 | 15/16 | 17 1/2 | 48 1/4 | 1 | 7 1/4 | 48 1/4 | 7 | 6 | 4 1/4 | |
| 17 1/2 | 1 3/8 | 1 | 17 1/2 | 54 1/4 | 1 1/16 | 7 1/4 | 54 1/4 | 8 | 6 | 4 1/4 | |
| 17 1/2 | 1 1/2 | 1 1/16 | 17 1/2 | 60 1/4 | 1 1/8 | 7 1/4 | 60 1/4 | 9 | 6 | 4 1/4 | |
| 17 1/2 | 1 5/8 | 1 1/8 | 17 1/2 | 66 1/4 | 1 3/16 | 7 1/4 | 66 1/4 | 10 | 6 | 4 1/4 | |
| 17 1/2 | 1 3/4 | 1 3/16 | 17 1/2 | 72 1/4 | 1 1/4 | 7 1/4 | 72 1/4 | 11 | 6 | 4 1/4 | |
| 17 1/2 | 1 7/8 | 1 1/4 | 17 1/2 | 72 1/4 | 1 5/16 | 7 1/4 | 72 1/4 | 11 | 6 | 4 1/4 | |
| 17 1/2 | 2 | 1 5/16 | 17 1/2 | 78 1/4 | 1 3/8 | 7 1/4 | 78 1/4 | 12 | 6 | 4 1/4 | |
| 18 | 1 1/4 | 15/16 | 18 | 54 1/4 | 1 | 7 1/2 | 54 1/4 | 8 | 6 | 4 1/2 | |
| 18 | 1 3/8 | 1 | 18 | 60 1/4 | 1 1/16 | 7 1/2 | 60 1/4 | 9 | 6 | 4 1/2 | |
| 18 | 1 1/2 | 1 1/16 | 18 | 60 1/4 | 1 1/8 | 7 1/2 | 60 1/4 | 9 | 6 | 4 1/2 | |
| 18 | 1 5/8 | 1 1/8 | 18 | 66 1/4 | 1 3/16 | 7 1/2 | 66 1/4 | 10 | 6 | 4 1/2 | |
| 18 | 1 3/4 | 1 3/16 | 18 | 72 1/4 | 1 1/4 | 7 1/2 | 72 1/4 | 11 | 6 | 4 1/2 | |
| 18 | 1 7/8 | 1 1/4 | 18 | 78 1/4 | 1 5/16 | 7 1/2 | 78 1/4 | 12 | 6 | 4 1/2 | |
| 18 | 2 | 1 5/16 | 18 | 84 1/4 | 1 3/8 | 7 1/2 | 84 1/4 | 13 | 6 | 4 1/2 | |
| 18 | 2 1/8 | 1 3/8 | 18 | 90 1/4 | 1 7/16 | 7 1/2 | 90 1/4 | 14 | 6 | 4 1/2 | |
| 18 1/2 | 1 1/4 | 15/16 | 18 1/2 | 54 1/4 | 1 | 7 3/4 | 54 1/4 | 8 | 6 | 4 3/4 | |
| 18 1/2 | 1 3/8 | 1 | 18 1/2 | 60 1/4 | 1 1/16 | 7 3/4 | 60 1/4 | 9 | 6 | 4 3/4 | |
| 18 1/2 | 1 1/2 | 1 1/16 | 18 1/2 | 66 1/4 | 1 1/8 | 7 3/4 | 66 1/4 | 10 | 6 | 4 3/4 | |
| 18 1/2 | 1 5/8 | 1 1/8 | 18 1/2 | 72 1/4 | 1 3/16 | 7 3/4 | 72 1/4 | 11 | 6 | 4 3/4 | |
| 18 1/2 | 1 3/4 | 1 3/16 | 18 1/2 | 72 1/4 | 1 1/4 | 7 3/4 | 72 1/4 | 11 | 6 | 4 3/4 | |
| 18 1/2 | 1 7/8 | 1 1/4 | 18 1/2 | 78 1/4 | 1 5/16 | 7 3/4 | 78 1/4 | 12 | 6 | 4 3/4 | |
| 18 1/2 | 2 | 1 5/16 | 18 1/2 | 84 1/4 | 1 3/8 | 7 3/4 | 84 1/4 | 13 | 6 | 4 3/4 | |
| 18 1/2 | 2 1/8 | 1 3/8 | 18 1/2 | 90 1/4 | 1 7/16 | 7 3/4 | 90 1/4 | 14 | 6 | 4 3/4 | |
| 19 | 1 1/4 | 15/16 | 19 | 54 1/4 | 1 | 8 | 54 1/4 | 8 | 6 | 5 | |
| 19 | 1 3/8 | 1 | 19 | 60 1/4 | 1 1/16 | 8 | 60 1/4 | 9 | 6 | 5 | |
| 19 | 1 1/2 | 1 1/16 | 19 | 66 1/4 | 1 1/8 | 8 | 66 1/4 | 10 | 6 | 5 | |
| 19 | 1 5/8 | 1 1/8 | 19 | 72 1/4 | 1 3/16 | 8 | 72 1/4 | 11 | 6 | 5 | |
| 19 | 1 3/4 | 1 3/16 | 19 | 78 1/4 | 1 1/4 | 8 | 78 1/4 | 12 | 6 | 5 | |
| 19 | 1 7/8 | 1 1/4 | 19 | 84 1/4 | 1 5/16 | 8 | 84 1/4 | 13 | 6 | 5 | |
| 19 | 2 | 1 5/16 | 19 | 90 1/4 | 1 3/8 | 8 | 90 1/4 | 14 | 6 | 5 | |
| 19 | 2 1/8 | 1 3/8 | 19 | 96 1/4 | 1 7/16 | 8 | 96 1/4 | 15 | 6 | 5 | |
| 19 1/2 | 1 1/4 | 15/16 | 19 1/2 | 60 1/4 | 1 | 8 1/4 | 60 1/4 | 9 | 6 | 5 1/4 | |
| 19 1/2 | 1 3/8 | 1 | 19 1/2 | 66 1/4 | 1 1/16 | 8 1/4 | 66 1/4 | 10 | 6 | 5 1/4 | |
| 19 1/2 | 1 1/2 | 1 1/16 | 19 1/2 | 66 1/4 | 1 1/8 | 8 1/4 | 66 1/4 | 10 | 6 | 5 1/4 | |
| 19 1/2 | 1 5/8 | 1 1/8 | 19 1/2 | 72 1/4 | 1 3/16 | 8 1/4 | 72 1/4 | 11 | 6 | 5 1/4 | |
| 19 1/2 | 1 3/4 | 1 3/16 | 19 1/2 | 78 1/4 | 1 1/4 | 8 1/4 | 78 1/4 | 12 | 6 | 5 1/4 | |
| 19 1/2 | 1 7/8 | 1 1/4 | 19 1/2 | 84 1/4 | 1 5/16 | 8 1/4 | 84 1/4 | 13 | 6 | 5 1/4 | |
| 19 1/2 | 2 | 1 5/16 | 19 1/2 | 90 1/4 | 1 3/8 | 8 1/4 | 90 1/4 | 14 | 6 | 5 1/4 | |
| 19 1/2 | 2 1/8 | 1 3/8 | 19 1/2 | 96 1/4 | 1 7/16 | 8 1/4 | 96 1/4 | 15 | 6 | 5 1/4 | |
| 20 | 1 1/4 | 15/16 | 20 | 60 1/4 | 1 | 8 1/2 | 60 1/4 | 9 | 6 | 5 1/2 | |
| 20 | 1 3/8 | 1 | 20 | 66 1/4 | 1 1/16 | 8 1/2 | 66 1/4 | 10 | 6 | 5 1/2 | |
| 20 | 1 1/2 | 1 1/16 | 20 | 72 1/4 | 1 1/8 | 8 1/2 | 72 1/4 | 11 | 6 | 5 1/2 | |
| 20 | 1 5/8 | 1 1/8 | 20 | 78 1/4 | 1 3/16 | 8 1/2 | 78 1/4 | 12 | 6 | 5 1/2 | |
| 20 | 1 3/4 | 1 3/16 | 20 | 84 1/4 | 1 1/4 | 8 1/2 | 84 1/4 | 13 | 6 | 5 1/2 | |
| 20 | 1 7/8 | 1 1/4 | 20 | 90 1/4 | 1 5/16 | 8 1/2 | 90 1/4 | 14 | 6 | 5 1/2 | |
| 20 | 2 | 1 5/16 | 20 | 96 1/4 | 1 3/8 | 8 1/2 | 96 1/4 | 15 | 6 | 5 1/2 | |
| 20 | 2 1/8 | 1 3/8 | 20 | 96 1/4 | 1 7/16 | 8 1/2 | 96 1/4 | 15 | 6 | 5 1/2 | |

Table 2 (Cont.)

| | |
|-------|-------------------------------|
| Steel | 50 ksi Web and 70 ksi Flanges |
|-------|-------------------------------|

Web Splices

| Web Size | | Plate Size | | | | | |
|-------------------|-----------------------|-----------------------|--------------------|--------------------|----|---------------|---|
| Depth (inches) | Thickness (inches) | Thickness (inches) | Length (inches) | Height (inches) | A | D (inches) | B |
| 40 | 9/16 | 3/8 | 13 | 37 | 11 | 3 | 1 |
| 40 | 5/8 | 3/8 | 13 | 37 | 11 | 3 | 1 |
| 40 | 11/16 | 3/8 | 19 | 37 | 11 | 3 | 2 |
| 42 | 5/8 | 3/8 | 13 | 39 | 12 | 3 | 1 |
| 42 | 11/16 | 3/8 | 19 | 39 | 12 | 3 | 2 |
| 42 | 3/4 | 7/16 | 19 | 39 | 12 | 3 | 2 |
| 44 | 5/8 | 3/8 | 13 | 41 | 12 | 3 1/8 | 1 |
| 44 | 11/16 | 3/8 | 19 | 41 | 12 | 3 1/8 | 2 |
| 44 | 3/4 | 7/16 | 19 | 41 | 12 | 3 1/8 | 2 |
| 46 | 11/16 | 3/8 | 19 | 43 | 13 | 3 | 2 |
| 46 | 3/4 | 7/16 | 19 | 43 | 13 | 3 | 2 |
| 46 | 13/16 | 7/16 | 25 | 43 | 13 | 3 | 3 |
| 48 | 11/16 | 3/8 | 13 | 45 | 14 | 3 | 1 |
| 48 | 3/4 | 7/16 | 19 | 45 | 14 | 3 | 2 |
| 48 | 13/16 | 7/16 | 19 | 45 | 14 | 3 | 2 |
| 50 | 3/4 | 7/16 | 19 | 47 | 14 | 3 1/8 | 2 |
| 50 | 13/16 | 7/16 | 19 | 47 | 14 | 3 1/8 | 2 |
| 50 | 7/8 | 1/2 | 25 | 47 | 14 | 3 1/8 | 3 |
| 52 | 3/4 | 7/16 | 19 | 49 | 15 | 3 | 2 |
| 52 | 13/16 | 7/16 | 19 | 49 | 15 | 3 | 2 |
| 52 | 7/8 | 1/2 | 25 | 49 | 15 | 3 | 3 |
| 54 | 3/4 | 7/16 | 13 | 51 | 16 | 3 | 1 |
| 54 | 13/16 | 7/16 | 19 | 51 | 16 | 3 | 2 |
| 54 | 7/8 | 1/2 | 19 | 51 | 16 | 3 | 2 |
| 56 | 13/16 | 7/16 | 19 | 53 | 16 | 3 1/8 | 2 |
| 56 | 7/8 | 1/2 | 19 | 53 | 16 | 3 1/8 | 2 |
| 56 | 15/16 | 1/2 | 25 | 53 | 16 | 3 1/8 | 3 |
| 58 | 13/16 | 7/16 | 19 | 55 | 17 | 3 | 2 |
| 58 | 7/8 | 1/2 | 19 | 55 | 17 | 3 | 2 |
| 58 | 15/16 | 1/2 | 25 | 55 | 17 | 3 | 3 |
| 60 | 7/8 | 1/2 | 19 | 57 | 18 | 3 | 2 |
| 60 | 15/16 | 1/2 | 19 | 57 | 18 | 3 | 2 |
| 60 | 1 | 9/16 | 25 | 57 | 18 | 3 | 3 |
| 62 | 7/8 | 1/2 | 19 | 59 | 18 | 3 | 2 |
| 62 | 15/16 | 1/2 | 19 | 59 | 18 | 3 | 2 |
| 62 | 1 | 9/16 | 25 | 59 | 18 | 3 | 3 |
| 64 | 15/16 | 1/2 | 19 | 61 | 19 | 3 | 2 |
| 64 | 1 | 9/16 | 25 | 61 | 19 | 3 | 3 |
| 66 | 15/16 | 1/2 | 19 | 63 | 20 | 3 | 2 |
| 66 | 1 | 9/16 | 19 | 63 | 20 | 3 | 2 |
| 68 | 1 | 9/16 | 19 | 65 | 20 | 3 | 2 |
| 70 | 1 | 9/16 | 19 | 67 | 21 | 3 | 2 |
| 72 | 1 | 9/16 | 19 | 69 | 22 | 3 | 2 |

Table 3

Steel 70 ksi

Flange Splices

| Flange Size | | Outside Plate Size | | | Inside Plate Size | | | C | E (inches) | F (inches) | G (inches) |
|-----------------------|-------------------|-----------------------|-------------------|--------------------|-----------------------|-------------------|--------------------|----|---------------|---------------|---------------|
| Thickness (inches) | Width (inches) | Thickness (inches) | Width (inches) | Length (inches) | Thickness (inches) | Width (inches) | Length (inches) | | | | |
| 12 | 7/8 | 3/4 | 12 | 64 | 13/16 | 4 1/2 | 64 | 11 | 6 | 1 1/2 | 2 5/8 |
| 12 | 1 | 13/16 | 12 | 74 1/2 | 7/8 | 4 1/2 | 74 1/2 | 13 | 6 | 1 1/2 | 2 5/8 |
| 12 | 1 1/8 | 7/8 | 12 | 79 3/4 | 15/16 | 4 1/2 | 79 3/4 | 14 | 6 | 1 1/2 | 2 5/8 |
| 12 1/2 | 7/8 | 3/4 | 12 1/2 | 61 1/4 | 13/16 | 4 3/4 | 61 1/4 | 11 | 6 | 1 3/4 | 2 1/2 |
| 12 1/2 | 1 | 13/16 | 12 1/2 | 71 1/4 | 7/8 | 4 3/4 | 71 1/4 | 13 | 6 | 1 3/4 | 2 1/2 |
| 12 1/2 | 1 1/8 | 7/8 | 12 1/2 | 81 1/4 | 15/16 | 4 3/4 | 81 1/4 | 15 | 6 | 1 3/4 | 2 1/2 |
| 13 | 7/8 | 3/4 | 13 | 55 3/4 | 13/16 | 5 | 55 3/4 | 11 | 6 | 2 | 2 1/4 |
| 13 | 1 | 13/16 | 13 | 64 3/4 | 7/8 | 5 | 64 3/4 | 13 | 6 | 2 | 2 1/4 |
| 13 | 1 1/8 | 7/8 | 13 | 73 3/4 | 15/16 | 5 | 73 3/4 | 15 | 6 | 2 | 2 1/4 |
| 13 1/2 | 7/8 | 3/4 | 13 1/2 | 54 1/4 | 13/16 | 5 1/4 | 54 1/4 | 12 | 6 | 2 1/4 | 2 |
| 13 1/2 | 1 | 13/16 | 13 1/2 | 58 1/4 | 7/8 | 5 1/4 | 58 1/4 | 13 | 6 | 2 1/4 | 2 |
| 13 1/2 | 1 1/8 | 7/8 | 13 1/2 | 66 1/4 | 15/16 | 5 1/4 | 66 1/4 | 15 | 6 | 2 1/4 | 2 |
| 13 1/2 | 1 1/4 | 15/16 | 13 1/2 | 74 1/4 | 1 | 5 1/4 | 74 1/4 | 17 | 6 | 2 1/4 | 2 |
| 14 | 1 | 13/16 | 14 | 55 1/4 | 7/8 | 5 1/2 | 55 1/4 | 14 | 6 | 2 1/2 | 1 3/4 |
| 14 | 1 1/8 | 7/8 | 14 | 58 3/4 | 15/16 | 5 1/2 | 58 3/4 | 15 | 6 | 2 1/2 | 1 3/4 |
| 14 | 1 1/4 | 15/16 | 14 | 65 3/4 | 1 | 5 1/2 | 65 3/4 | 17 | 6 | 2 1/2 | 1 3/4 |
| 14 | 1 3/8 | 1 | 14 | 72 3/4 | 1 1/16 | 5 1/2 | 72 3/4 | 19 | 6 | 2 1/2 | 1 3/4 |
| 14 1/2 | 1 | 13/16 | 14 1/2 | 48 1/4 | 7/8 | 5 3/4 | 48 1/4 | 14 | 6 | 2 3/4 | 1 1/2 |
| 14 1/2 | 1 1/8 | 7/8 | 14 1/2 | 54 1/4 | 15/16 | 5 3/4 | 54 1/4 | 16 | 6 | 2 3/4 | 1 1/2 |
| 14 1/2 | 1 1/4 | 15/16 | 14 1/2 | 60 1/4 | 1 | 5 3/4 | 60 1/4 | 18 | 6 | 2 3/4 | 1 1/2 |
| 14 1/2 | 1 3/8 | 1 | 14 1/2 | 63 1/4 | 1 1/16 | 5 3/4 | 63 1/4 | 19 | 6 | 2 3/4 | 1 1/2 |
| 14 1/2 | 1 1/2 | 1 1/16 | 14 1/2 | 69 1/4 | 1 1/8 | 5 3/4 | 69 1/4 | 21 | 6 | 2 3/4 | 1 1/2 |
| 14 1/2 | 1 5/8 | 1 1/8 | 14 1/2 | 75 1/4 | 1 3/16 | 5 3/4 | 75 1/4 | 23 | 6 | 2 3/4 | 1 1/2 |
| 15 | 1 | 13/16 | 15 | 48 1/4 | 7/8 | 6 | 48 1/4 | 7 | 6 | 3 | |
| 15 | 1 1/8 | 7/8 | 15 | 54 1/4 | 15/16 | 6 | 54 1/4 | 8 | 6 | 3 | |
| 15 | 1 1/4 | 15/16 | 15 | 60 1/4 | 1 | 6 | 60 1/4 | 9 | 6 | 3 | |
| 15 | 1 3/8 | 1 | 15 | 66 1/4 | 1 1/16 | 6 | 66 1/4 | 10 | 6 | 3 | |
| 15 | 1 1/2 | 1 1/16 | 15 | 72 1/4 | 1 1/8 | 6 | 72 1/4 | 11 | 6 | 3 | |
| 15 | 1 5/8 | 1 1/8 | 15 | 72 1/4 | 1 3/16 | 6 | 72 1/4 | 11 | 6 | 3 | |
| 15 | 1 3/4 | 1 3/16 | 15 | 78 1/4 | 1 1/4 | 6 | 78 1/4 | 12 | 6 | 3 | |
| 15 1/2 | 1 | 13/16 | 15 1/2 | 48 1/4 | 7/8 | 6 1/4 | 48 1/4 | 7 | 6 | 3 1/4 | |
| 15 1/2 | 1 1/8 | 7/8 | 15 1/2 | 54 1/4 | 15/16 | 6 1/4 | 54 1/4 | 8 | 6 | 3 1/4 | |
| 15 1/2 | 1 1/4 | 15/16 | 15 1/2 | 60 1/4 | 1 | 6 1/4 | 60 1/4 | 9 | 6 | 3 1/4 | |
| 15 1/2 | 1 3/8 | 1 | 15 1/2 | 66 1/4 | 1 1/16 | 6 1/4 | 66 1/4 | 10 | 6 | 3 1/4 | |
| 15 1/2 | 1 1/2 | 1 1/16 | 15 1/2 | 72 1/4 | 1 1/8 | 6 1/4 | 72 1/4 | 11 | 6 | 3 1/4 | |
| 15 1/2 | 1 5/8 | 1 1/8 | 15 1/2 | 78 1/4 | 1 3/16 | 6 1/4 | 78 1/4 | 12 | 6 | 3 1/4 | |
| 15 1/2 | 1 3/4 | 1 3/16 | 15 1/2 | 84 1/4 | 1 1/4 | 6 1/4 | 84 1/4 | 13 | 6 | 3 1/4 | |
| 16 | 1 1/8 | 7/8 | 16 | 54 1/4 | 15/16 | 6 1/2 | 54 1/4 | 8 | 6 | 3 1/2 | |
| 16 | 1 1/4 | 15/16 | 16 | 60 1/4 | 1 | 6 1/2 | 60 1/4 | 9 | 6 | 3 1/2 | |
| 16 | 1 3/8 | 1 | 16 | 66 1/4 | 1 1/16 | 6 1/2 | 66 1/4 | 10 | 6 | 3 1/2 | |
| 16 | 1 1/2 | 1 1/16 | 16 | 72 1/4 | 1 1/8 | 6 1/2 | 72 1/4 | 11 | 6 | 3 1/2 | |
| 16 | 1 5/8 | 1 1/8 | 16 | 78 1/4 | 1 3/16 | 6 1/2 | 78 1/4 | 12 | 6 | 3 1/2 | |
| 16 | 1 3/4 | 1 3/16 | 16 | 84 1/4 | 1 1/4 | 6 1/2 | 84 1/4 | 13 | 6 | 3 1/2 | |
| 16 | 1 7/8 | 1 1/4 | 16 | 90 1/4 | 1 5/16 | 6 1/2 | 90 1/4 | 14 | 6 | 3 1/2 | |
| 16 | 2 | 1 5/16 | 16 | 96 1/4 | 1 3/8 | 6 1/2 | 96 1/4 | 15 | 6 | 3 1/2 | |
| 16 1/2 | 1 1/8 | 7/8 | 16 1/2 | 60 1/4 | 15/16 | 6 3/4 | 60 1/4 | 9 | 6 | 3 3/4 | |
| 16 1/2 | 1 1/4 | 15/16 | 16 1/2 | 66 1/4 | 1 | 6 3/4 | 66 1/4 | 10 | 6 | 3 3/4 | |
| 16 1/2 | 1 3/8 | 1 | 16 1/2 | 72 1/4 | 1 1/16 | 6 3/4 | 72 1/4 | 11 | 6 | 3 3/4 | |
| 16 1/2 | 1 1/2 | 1 1/16 | 16 1/2 | 78 1/4 | 1 1/8 | 6 3/4 | 78 1/4 | 12 | 6 | 3 3/4 | |
| 16 1/2 | 1 5/8 | 1 1/8 | 16 1/2 | 84 1/4 | 1 3/16 | 6 3/4 | 84 1/4 | 13 | 6 | 3 3/4 | |
| 16 1/2 | 1 3/4 | 1 3/16 | 16 1/2 | 90 1/4 | 1 1/4 | 6 3/4 | 90 1/4 | 14 | 6 | 3 3/4 | |
| 16 1/2 | 1 7/8 | 1 1/4 | 16 1/2 | 96 1/4 | 1 5/16 | 6 3/4 | 96 1/4 | 15 | 6 | 3 3/4 | |
| 16 1/2 | 2 | 1 5/16 | 16 1/2 | 102 1/4 | 1 3/8 | 6 3/4 | 102 1/4 | 16 | 6 | 3 3/4 | |

Table 4

Steel 70 ksi

Flange Splices

| Flange Size | | Outside Plate Size | | | Inside Plate Size | | | C | E (inches) | F (inches) | G (inches) |
|-----------------------|-------------------|-----------------------|-------------------|--------------------|-----------------------|-------------------|--------------------|----|---------------|---------------|---------------|
| Thickness (inches) | Width (inches) | Thickness (inches) | Width (inches) | Length (inches) | Thickness (inches) | Width (inches) | Length (inches) | | | | |
| 17 | 1 1/8 | 7/8 | 17 | 60 1/4 | 15/16 | 7 | 60 1/4 | 9 | 6 | 4 | |
| 17 | 1 1/4 | 15/16 | 17 | 66 1/4 | 1 | 7 | 66 1/4 | 10 | 6 | 4 | |
| 17 | 1 3/8 | 1 | 17 | 72 1/4 | 1 1/16 | 7 | 72 1/4 | 11 | 6 | 4 | |
| 17 | 1 1/2 | 1 1/16 | 17 | 78 1/4 | 1 1/8 | 7 | 78 1/4 | 12 | 6 | 4 | |
| 17 | 1 5/8 | 1 1/8 | 17 | 90 1/4 | 1 3/16 | 7 | 90 1/4 | 14 | 6 | 4 | |
| 17 | 1 3/4 | 1 3/16 | 17 | 96 1/4 | 1 1/4 | 7 | 96 1/4 | 15 | 6 | 4 | |
| 17 | 1 7/8 | 1 1/4 | 17 | 102 1/4 | 1 5/16 | 7 | 102 1/4 | 16 | 6 | 4 | |
| 17 | 2 | 1 5/16 | 17 | 108 1/4 | 1 3/8 | 7 | 108 1/4 | 17 | 6 | 4 | |
| 17 1/2 | 1 1/4 | 15/16 | 17 1/2 | 72 1/4 | 1 | 7 1/4 | 72 1/4 | 11 | 6 | 4 1/4 | |
| 17 1/2 | 1 3/8 | 1 | 17 1/2 | 78 1/4 | 1 1/16 | 7 1/4 | 78 1/4 | 12 | 6 | 4 1/4 | |
| 17 1/2 | 1 1/2 | 1 1/16 | 17 1/2 | 84 1/4 | 1 1/8 | 7 1/4 | 84 1/4 | 13 | 6 | 4 1/4 | |
| 17 1/2 | 1 5/8 | 1 1/8 | 17 1/2 | 90 1/4 | 1 3/16 | 7 1/4 | 90 1/4 | 14 | 6 | 4 1/4 | |
| 17 1/2 | 1 3/4 | 1 3/16 | 17 1/2 | 96 1/4 | 1 1/4 | 7 1/4 | 96 1/4 | 15 | 6 | 4 1/4 | |
| 17 1/2 | 1 7/8 | 1 1/4 | 17 1/2 | 102 1/4 | 1 5/16 | 7 1/4 | 102 1/4 | 16 | 6 | 4 1/4 | |
| 17 1/2 | 2 | 1 5/16 | 17 1/2 | 108 1/4 | 1 3/8 | 7 1/4 | 108 1/4 | 17 | 6 | 4 1/4 | |
| 17 1/2 | 2 1/8 | 1 3/8 | 17 1/2 | 114 1/4 | 1 7/16 | 7 1/4 | 114 1/4 | 18 | 6 | 4 1/4 | |
| 18 | 1 1/4 | 15/16 | 18 | 72 1/4 | 1 | 7 1/2 | 72 1/4 | 11 | 6 | 4 1/2 | |
| 18 | 1 3/8 | 1 | 18 | 78 1/4 | 1 1/16 | 7 1/2 | 78 1/4 | 12 | 6 | 4 1/2 | |
| 18 | 1 1/2 | 1 1/16 | 18 | 84 1/4 | 1 1/8 | 7 1/2 | 84 1/4 | 13 | 6 | 4 1/2 | |
| 18 | 1 5/8 | 1 1/8 | 18 | 96 1/4 | 1 3/16 | 7 1/2 | 96 1/4 | 15 | 6 | 4 1/2 | |
| 18 | 1 3/4 | 1 3/16 | 18 | 102 1/4 | 1 1/4 | 7 1/2 | 102 1/4 | 16 | 6 | 4 1/2 | |
| 18 | 1 7/8 | 1 1/4 | 18 | 108 1/4 | 1 5/16 | 7 1/2 | 108 1/4 | 17 | 6 | 4 1/2 | |
| 18 | 2 | 1 5/16 | 18 | 114 1/4 | 1 3/8 | 7 1/2 | 114 1/4 | 18 | 6 | 4 1/2 | |
| 18 | 2 1/8 | 1 3/8 | 18 | 120 1/4 | 1 7/16 | 7 1/2 | 120 1/4 | 19 | 6 | 4 1/2 | |
| 18 1/2 | 1 1/4 | 15/16 | 18 1/2 | 72 1/4 | 1 | 7 3/4 | 72 1/4 | 11 | 6 | 4 3/4 | |
| 18 1/2 | 1 3/8 | 1 | 18 1/2 | 84 1/4 | 1 1/16 | 7 3/4 | 84 1/4 | 13 | 6 | 4 3/4 | |
| 18 1/2 | 1 1/2 | 1 1/16 | 18 1/2 | 90 1/4 | 1 1/8 | 7 3/4 | 90 1/4 | 14 | 6 | 4 3/4 | |
| 18 1/2 | 1 5/8 | 1 1/8 | 18 1/2 | 96 1/4 | 1 3/16 | 7 3/4 | 96 1/4 | 15 | 6 | 4 3/4 | |
| 18 1/2 | 1 3/4 | 1 3/16 | 18 1/2 | 102 1/4 | 1 1/4 | 7 3/4 | 102 1/4 | 16 | 6 | 4 3/4 | |
| 18 1/2 | 1 7/8 | 1 1/4 | 18 1/2 | 108 1/4 | 1 5/16 | 7 3/4 | 108 1/4 | 17 | 6 | 4 3/4 | |
| 18 1/2 | 2 | 1 5/16 | 18 1/2 | 120 1/4 | 1 3/8 | 7 3/4 | 120 1/4 | 19 | 6 | 4 3/4 | |
| 18 1/2 | 2 1/8 | 1 3/8 | 18 1/2 | 126 1/4 | 1 7/16 | 7 3/4 | 126 1/4 | 20 | 6 | 4 3/4 | |
| 19 | 1 1/4 | 15/16 | 19 | 78 1/4 | 1 | 8 | 78 1/4 | 12 | 6 | 5 | |
| 19 | 1 3/8 | 1 | 19 | 84 1/4 | 1 1/16 | 8 | 84 1/4 | 13 | 6 | 5 | |
| 19 | 1 1/2 | 1 1/16 | 19 | 90 1/4 | 1 1/8 | 8 | 90 1/4 | 14 | 6 | 5 | |
| 19 | 1 5/8 | 1 1/8 | 19 | 102 1/4 | 1 3/16 | 8 | 102 1/4 | 16 | 6 | 5 | |
| 19 | 1 3/4 | 1 3/16 | 19 | 108 1/4 | 1 1/4 | 8 | 108 1/4 | 17 | 6 | 5 | |
| 19 | 1 7/8 | 1 1/4 | 19 | 114 1/4 | 1 5/16 | 8 | 114 1/4 | 18 | 6 | 5 | |
| 19 | 2 | 1 5/16 | 19 | 120 1/4 | 1 3/8 | 8 | 120 1/4 | 19 | 6 | 5 | |
| 19 | 2 1/8 | 1 3/8 | 19 | 132 1/4 | 1 7/16 | 8 | 132 1/4 | 21 | 6 | 5 | |
| 19 1/2 | 1 3/8 | 1 | 19 1/2 | 90 1/4 | 1 1/16 | 8 1/4 | 90 1/4 | 14 | 6 | 5 1/4 | |
| 19 1/2 | 1 1/2 | 1 1/16 | 19 1/2 | 96 1/4 | 1 1/8 | 8 1/4 | 96 1/4 | 15 | 6 | 5 1/4 | |
| 19 1/2 | 1 5/8 | 1 1/8 | 19 1/2 | 102 1/4 | 1 3/16 | 8 1/4 | 102 1/4 | 16 | 6 | 5 1/4 | |
| 19 1/2 | 1 3/4 | 1 3/16 | 19 1/2 | 108 1/4 | 1 1/4 | 8 1/4 | 108 1/4 | 17 | 6 | 5 1/4 | |
| 19 1/2 | 1 7/8 | 1 1/4 | 19 1/2 | 120 1/4 | 1 5/16 | 8 1/4 | 120 1/4 | 19 | 6 | 5 1/4 | |
| 19 1/2 | 2 | 1 5/16 | 19 1/2 | 126 1/4 | 1 3/8 | 8 1/4 | 126 1/4 | 20 | 6 | 5 1/4 | |
| 19 1/2 | 2 1/8 | 1 3/8 | 19 1/2 | 132 1/4 | 1 7/16 | 8 1/4 | 132 1/4 | 21 | 6 | 5 1/4 | |
| 20 | 1 3/8 | 1 | 20 | 90 1/4 | 1 1/16 | 8 1/2 | 90 1/4 | 14 | 6 | 5 1/2 | |
| 20 | 1 1/2 | 1 1/16 | 20 | 96 1/4 | 1 1/8 | 8 1/2 | 96 1/4 | 15 | 6 | 5 1/2 | |
| 20 | 1 5/8 | 1 1/8 | 20 | 108 1/4 | 1 3/16 | 8 1/2 | 108 1/4 | 17 | 6 | 5 1/2 | |
| 20 | 1 3/4 | 1 3/16 | 20 | 114 1/4 | 1 1/4 | 8 1/2 | 114 1/4 | 18 | 6 | 5 1/2 | |
| 20 | 1 7/8 | 1 1/4 | 20 | 120 1/4 | 1 5/16 | 8 1/2 | 120 1/4 | 19 | 6 | 5 1/2 | |
| 20 | 2 | 1 5/16 | 20 | 132 1/4 | 1 3/8 | 8 1/2 | 132 1/4 | 21 | 6 | 5 1/2 | |
| 20 | 2 1/8 | 1 3/8 | 20 | 138 1/4 | 1 7/16 | 8 1/2 | 138 1/4 | 22 | 6 | 5 1/2 | |

Table 4 (Cont.)